Emergency Department Pharmacists Improve Patient Safety: Results of a Multicenter Study

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Background and Methodology

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Grady Health System

Iatrogenic Injury
- Institute of Medicine (IOM) Report- 1999
  Medical errors kill 44,000-98,000 annually
- Harvard Medical Practice Study (1991)
  3.7% inpatient adverse event rate
  - Errors in management (50%)
  - Medication use (19%)

Complex Systems in Healthcare

Adverse Drug Event (ADE)

- Injury due to a drug
  - Preventable
  - Non-preventable
  - Ameliorable
- Potential ADE (near miss)
  - Medication error that has the potential to cause an injury
    - Intercepted, or luck
Inpatient Adverse Drug Events
- 6.5 ADEs / 100 admissions
  - 28% preventable
  - 3 potential ADEs for every preventable ADE
  - Ordering and transcription (62%)
- Systems analysis
  - No individual responsible for repeated errors


Definition of Quality
- **Overuse**: Treatment risk exceeds benefit
- **Underuse**: Failure to provide a treatment when it would have provided a favorable outcome
- **Misuse**: Treatment results in preventable complication that reduces benefit

JAMA 1998;280(11):1000-05

Pharmacist Optimization of Care
- Quality Standards/Current Evidence
- ABC-2015
- TPC-2015
- LUR-2015
- 2015 HOPA
- NACB Resources
- EBM

Clinical challenges in the emergency department
- Providers focused on stabilization (ABC’s)
- Safety mechanisms not in place
  - Verbal orders
  - High stress situations
- Lack of information
  - Limited patient data

ED Challenges to Patient Care
- Boarding of admitted patients
- Multiple patients treated simultaneously
- On-call physician shortage
- ED visits up 26%
- Wide range of medications used

http://www.acep.org/advocacy.aspx?id=21870
http://www.cdc.gov/nchs/data/ad/ad358.pdf

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Medication Errors in the ED
- More than 75% ED visits associated with medication administration or prescribing
- >210 million medication encounters annually
- Higher prevalence of preventable adverse events
  - Elderly patients (N=898)
    - 3.6% in the ED
    - 5.6% upon discharge

MEDMARX ED Med Errors
- 13,932 errors from 496 ED
  - 78 per 100,000 visits

Characteristics
- Administration phase
- Improper dose
- Failure to follow procedures

ED Pharmacist Roles

<table>
<thead>
<tr>
<th>Prospective Medication Order Review</th>
<th>Participate in ED team patient rounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admission Medication Histories (Medication Reconciliation)</td>
<td>Monitoring therapeutic responses / laboratory results</td>
</tr>
<tr>
<td>Clinical Consultations</td>
<td>Medical Code Team Involvement</td>
</tr>
<tr>
<td>Provide Drug Information</td>
<td>Trauma Code Team Involvement</td>
</tr>
<tr>
<td>Review chief complaints for potential ADR</td>
<td>Critical / Emergent Patient Involvement</td>
</tr>
<tr>
<td>Review for Adherence to Guidelines and Regulatory Core Measures</td>
<td>Medication Preparation in the ED</td>
</tr>
<tr>
<td>Provide Patient Education on Medication Use Upon Discharge Administration of Medications</td>
<td>Dispensing Discharge Medications</td>
</tr>
<tr>
<td>Administer medications</td>
<td>Provide Continuity of Care for Boarded Patients</td>
</tr>
</tbody>
</table>

Role of the pharmacist in the emergency department

Literature Supporting ED Pharmacy

- Improved compliance
  - Fairbanks et al.
  - Benavides et al.
  - Hayes et al.
  - Miazon et al.
- Drug information
  - Berry NS et al.
  - Czajka et al.
  - Kasuya A et al.
- Cost Savings
  - Faribanks et al.
  - Lada et al.
  - Ling et al.
  - Whalen FJ et al.

Study Methodology
Pilot Study

- 4 Sites: CA, GA, MA, WI
- Objectives
  - To determine the incidence and type of MEs and prevented ADEs recovered by ED pharmacists
  - To classify MEs according to the type of error and the nature of recovery
    - Successful interventions: did not reach patients and prevented or reduced harm

Methodology

- 200 hrs of direct observation per site
  - Two to six hour periods
  - Aug to Dec 2008
- Observations scheduled during the busiest work hours
  - 4-10 pm
- Observers - pharmacy residents

Direct Observational Method

- Trained observers shadow caregivers
- Goals
  - Catch otherwise undetected medication errors and potential ADEs
  - Improve understanding of the medication-use process
  - Standard for medication errors

Outcome Measures

- Pharmacist intervention
  - Discrete activities related to patient care
- Suspected medication errors interventions
  - Pharmacist interventions witnessed by the observers
    - Confirmed as recovered medication errors, or excluded

Definitions (1)

- Medication errors
  - Any error in the medication use process
    - Prescribing, transcription, dispensing, administering, and monitoring
- Recovered medical errors
  - Intercepted potential ADEs, mitigated potential ADEs, and ameliorated ADEs

Definitions (2)

- Intercepted potential ADE - A medical error with the potential to cause harm that was intercepted before reaching the patient
- Mitigated potential ADE - A medical error with the potential to cause harm that reached the patient but recovered before harm occurred
- Ameliorated ADE - Injury due to a medical error that reached the patient but whose subsequent potential severity was significantly reduced as a consequence of later recovering the error before further harm took place
Secondary Outcomes

- Type of recovered medication error intervention
  - Wrong patient, wrong drug, drug omission, etc.
- The proportion of recommendations that were accepted or denied
- The nature of the pharmacy intervention associated with a recovered medication error
  - i.e. contacting the nurse of an incorrect medication preparation or administration

Quality Analysis

- Evaluation & classification of quality interventions
  - Originally excluded
- Classified by
  - Avoidance of quality problems
  - Adherence to quality indicators & EBM
- Two investigators performed evaluations

Results

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Data Collected

- Cumulative Data:
  - 227 observation periods
  - 791 hours at 4 EDs
  - Pharmacists reviewed 17,320 medications that were ordered or administered
  - 6,471 patients affected
- Mean Data per Observation Period:
  - Mean number of medications = 76.6
  - Mean number of patients = 28.6
  - Average observation period = 3.5 hour

Characteristics of Study Emergency Departments

<table>
<thead>
<tr>
<th>Site</th>
<th>Hospital A</th>
<th>Hospital B</th>
<th>Hospital C</th>
<th>Hospital D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual ED Visits</td>
<td>77,000</td>
<td>37,000</td>
<td>104,000</td>
<td>56,600</td>
</tr>
<tr>
<td>ED Beds</td>
<td>41</td>
<td>29</td>
<td>124</td>
<td>46</td>
</tr>
<tr>
<td>Pediatric patients</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Observation unit in ED</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Trauma Designation</td>
<td>Level 1</td>
<td>Level 1</td>
<td>Level 1</td>
<td>Level 1</td>
</tr>
<tr>
<td>ED Computerized Physician Order Entry</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Emergency medicine residency program</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Full Time Equivalent ED Pharmacists</td>
<td>3</td>
<td>2.4</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>ED pharmacist coverage - total hours per week</td>
<td>112</td>
<td>97</td>
<td>107</td>
<td>168</td>
</tr>
<tr>
<td>ED pharmacist coverage by day and time</td>
<td>Mon - Sat: 8AM – 11PM</td>
<td>Mon - Sat: 8AM – 11PM</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sat - Sun: 3PM – 1AM</td>
<td>Sat - Sun: 3PM – 1AM</td>
<td></td>
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</tr>
</tbody>
</table>

Observations and Recovered Errors

<table>
<thead>
<tr>
<th>Hospital Site</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medications reviewed by RPh</td>
<td>3404</td>
<td>3702</td>
<td>3496</td>
<td>6718</td>
<td>17320</td>
</tr>
<tr>
<td>Medications reviewed per session</td>
<td>56.7</td>
<td>75.6</td>
<td>54.8</td>
<td>126.8</td>
<td>78.6</td>
</tr>
<tr>
<td>Recovered MEs</td>
<td>148</td>
<td>80</td>
<td>110</td>
<td>199</td>
<td>505</td>
</tr>
<tr>
<td>Recovered MEs per 100 pts</td>
<td>6.2</td>
<td>8.2</td>
<td>9.6</td>
<td>8.5</td>
<td>7.8</td>
</tr>
<tr>
<td>Recovered MEs per 100 meds</td>
<td>4.29</td>
<td>2.16</td>
<td>3.16</td>
<td>2.52</td>
<td>2.92</td>
</tr>
</tbody>
</table>
Types of Recovered Errors

<table>
<thead>
<tr>
<th>Type of ME</th>
<th>n (%)</th>
<th>Examples of the Most Frequently Recovered Medication Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underdose</td>
<td>94 (16.8)</td>
<td>Order received for a loading dose of 1400 mg acetylcysteine for a 100 kg pt. with an acetaminophen overdose. The RPh corrected the dose to 14000 mg.</td>
</tr>
<tr>
<td>Overdose</td>
<td>87 (12.5)</td>
<td>Order received for a heparin infusion rate at 500 units/hour but was transcribed by the nurse as 500 units/kg/hour. The RPh corrected the error.</td>
</tr>
<tr>
<td>Drug Omission</td>
<td>59 (10.5)</td>
<td>Order received for Ca gluconate, Kayexalate and insulin to treat severe hyperkalemia. The RPh noticed the blood glucose of 100 mg/dl and recommended adding 50 gms IV dextrose.</td>
</tr>
<tr>
<td>Wrong Drug</td>
<td>38 (6.8)</td>
<td>Order received for succinylcholine for RSI of a patient with a K+ of 8.3. The RPh recommended changing to rocuronium.</td>
</tr>
</tbody>
</table>

Summary of Results (1)
- ED RPhs Interventions:
  - 25.7 potentially harmful MEs (mean) per 40 hours of observation
  - 48% judged potentially serious
  - 36% significant
  - 4.4% judged life-threatening
- 96.8% of ED Pharmacist recommendations were accepted

Summary of Results (2)
- Status of Recovered Potentially Harmful ADEs:
  - Intercepted 90.3%
  - Mitigated 3.9%
  - Ameliorated 0.2%
- Most Common Medications Intervened on:
  - Antimicrobials 32%
  - CNS agents 16%
  - Anticoagulant/lytics 14%

Sub-set Analysis of Pharmacist’s Quality of Care Interventions
- Objective: to evaluate & classify ED pharmacist quality of care interventions
  - Excluded MEs from initial study that were quality interventions (QIs)
  - Classified by: avoidance of quality problems, adherence to nationally-adopted quality indicators & current evidence based medicine.

Pharmacist Optimization of Care

Subgroup Analysis: Results
- Total QIs Identified: 54
  - 2.6 QIs per 100 patients
  - 11.7 QIs per 1000 medications
- % Agreement on QIs: 89.4%
Conclusions

- ED Pharmacists commonly recover and prevent potentially harmful MEs and improve patient safety.
- Sub-analysis shows that ED pharmacists also commonly play a critical role in improving the quality of patient care by improving drug treatment regimens.
- Controlled trials are necessary to fully determine the net cost-benefit effects of ED Pharmacist staffing on safety, quality and costs.
  - This is an especially important consideration for smaller emergency and pharmacy departments.